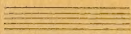


MURDOCH (F. H.)

STOMACH
DIGESTION.



BY

DR. FRANK H. MURDOCH,

PITTSBURGH, PA.

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STOMACH DIGESTION.

BY DR. FRANK H. MURDOCH.

PITTSBURGH, PA.

Physiologists divide digestion into seven stages: Prehension, mastication, insalivation, stomach and intestinal digestion, and defecation. This evening we have to do with digestion as it occurs in the stomach, which, as we know, is one of the most important, and, at the same time, one of the most abused organs in the human body. This habit of abusing the stomach seems to have been practiced at a very early age in the world's history, for the ancient Egyptians taught that "The greater part of the aliment taken is superfluous, which superfluity is the cause of all our distempers;" and Hippocrates taught that "Excess in drinking is not quite as bad as excess in eating."

The capacity of the human stomach is from eight to fifty-six ounces. When it holds



more than fifty-seven ounces, Ewald considers it to be in a condition of dilatation. During rest, the stomach should be empty or contain at most only a small quantity of clear mucus.

During digestion it becomes a closed sac. Its contents are subjected to a sort of churning motion from the contraction of its walls, and, at the same time, a free secretion of gastric juice takes place from the gastric glands.

As soon as any portion of the contents becomes properly prepared, the pyloric orifice opens to allow of its passage into the intestine. This is repeated at intervals until, in the course of a few hours, the stomach becomes empty, and then the peristaltic action ceases, as does also the secretion of gastric juice, until food is again taken into it.

Gastric juice is a clear, colorless fluid, of a specific gravity of from 1002 to 1003, and, besides hydrochloric acid, contains two ferments, rennet and pepsin. The amount secreted in twenty-four hours is about seven liters, or nearly one-tenth of the body weight.

The glands which secrete the gastric juice

open upon the mucous membrane of the stomach and are of two classes, the cardiac and the pyloric.

The cardiac glands are tubular and several open upon the surface by one duct. They are lined by two kinds of cells, one, forming the greater number, are the chief, central or adelomorphous cells for the secretion of pepsin and rennet. The other larger, but also granular and nucleated, are the parietal, dilomorphous, or oxyntic cells for the secretion of hydrochloric acid. The pyloric glands are without the parietal cells, and consequently do not secrete hydrochloric acid, but pepsin and rennet only.

The epithelial lining of the mucous coat of the stomach is formed partly by columnar cells, and partly by goblet cells for the secretion of mucus.

Pepsin and rennet are not secreted by the gastric glands as such, but exist in a preliminary stage, the one as a proenzyme or rennet zymogen; the other as pepsinogen, both requiring the presence of an acid, especially hydrochloric acid, to convert them into active ferments. Rennet precipitates the casein of the milk, and with it the fat, leav-

ing a liquid part which contains the salts and lactose. As the gastric filtrate, although neutral in reaction, may contain both rennet zymogen and pepsinogen, it should be acidulated with hydrochloric acid before making the test for either rennet or pepsin.

Rennet, like pepsin, is a constant constituent of the gastric juice, and its absence indicates atrophy of the gastric mucosa, although Einhorn has reported two cases where, for a long time, there was entire absence of gastric juice, but where eventually it reappeared in almost normal quantity.

Pepsin, in the presence of an acid, has the power of transforming albumin, whether egg, serum, plant albumin, or casein, into a soluble and easily diffusible form, peptone. Propeptone is a transformation product of albumin, absent in the digestion of meat, but present in the digestion of plant albuminates and pure egg albumen, hence always found in an ordinary mixed diet. Its presence in abundance at the end of an hour after the test breakfast, indicates an abnormally slow digestion of the nitrogenous part of the food, for it should have been converted into peptone, or, at least, be found only in traces.

Ewald has shown that peptone may be formed in the presence of other acids than hydrochloric acid, especially lactic acid; and, artificially, at least a certain amount of digestion takes place at the end of an hour and forty minutes in a test tube containing a solution of coagulated albumin, water, pepsin, and acetic acid; but when a similar mixture is acidulated with butyric acid, and treated in the same manner, no digestion whatever takes place (Martin).

As early as ten or fifteen minutes after taking food, the stomach contents obtained, are acid, the acidity depending for the first half hour upon the presence of lactic acid. For the next half hour, hydrochloric acid exists with the lactic acid; but after the first hour hydrochloric acid alone should be found. Lactic, acetic and butyric acids are not secreted by the gastric glands, but are either swallowed with the food, or formed in the stomach from the non-nitrogenous part of the food by bacterial fermentation.

The normal acidity of the gastric juice is from forty to sixty, but in patients complaining of stomach trouble, this condition is very rarely found. In a series of five hundred and sixty-four cases examined by Ein-

horn, the acidity was normal only ninety-one times. In one hundred and eighty-seven cases there was too little acid, and in two hundred and eighty-six cases, too much. In one hundred and twenty cases hydrochloric acid was entirely absent. In twenty-six cases in which I have recently examined the gastric juice, the acidity was not normal in a single instance. In five of the cases it was too low; and, in all these cases hydrochloric acid was absent, while in the remaining twenty-one cases the degree of acidity was too high.

Hydrochloric acid acts in several ways in the stomach. It stimulates the peristaltic action, it develops active ferments out of inactive pro-enzymes, and, with the aid of pepsin, converts albumin into peptone. It has nothing to do with the digestion of the carbohydrates of the food.

The digestion of starch begins in the mouth, the ptyalin of the saliva converting a certain portion of it into sugar. But the action of the ptyalin does not stop in the mouth, for the saliva which is swallowed with the food continues its action on the amylaceous substances, even in the stomach, until its action is arrested by the acid

of the gastric juice. No further change takes place until the stomach empties itself into the duodenum, where the acid chyme, coming in contact with the pancreatic juice, is rendered alkaline, and the digestion of the starch is completed.

As albumins are changed into propeptone before being converted into peptone, so starch is changed into erythrodextrin, and then into achroodextrin, before being finally converted into sugar, so that at the end of an hour after the test breakfast if erythrodextrin be found, we know that the digestion of starch is abnormally slow.

The conditions interfering with stomach digestion are, improper quality or quantity of food, bad teeth, insufficient mastication, absence of hydrochloric acid, too low or too high a degree of acidity, whether due to hydrochloric acid, or to the presence of organic acids, diminished absorption, and dilatation or loss of motor power due to atony of the muscular coats.

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